Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

**Theoretical and Percent Yield Lab**

**Introduction**

Chemical reactions are represented by balanced chemical equations. Correct interpretation of an equation provides a great deal of information about the reaction it represents and about the substances involved in the reaction. For example, the coefficients in a balanced equation indicate the number of moles of each substance. Thus, the ratio of moles of a substance to moles of any other substance in the reaction can be determined at a glance.

In this experiment, iron metal will be added to an aqueous solution of copper(II) sulfate. Your task is to determine the theoretical yield of solid copper, actual yield of solid copper, and percent yield.

The balanced equation for this reaction is below:

***3 CuSO4****•****5H2O + 2 Fe 🡪 Fe2(SO4)3 + 3 Cu + 15 H2O***

**Materials**

* 2 250-mL beakers
* 100-mL graduated cylinder
* Ring stand
* Iron ring
* Bunsen burner
* Spark lighter
* Iron filings
* Copper sulfate pentahydrate
* Filter paper
* Two weigh boats
* Scoopula
* Thermometer
* 250-mL Erlenmeyer flask
* Wire gauze
* Funnel
* Tongs
* Distilled water (approximately 250mL)

**Pre-Lab Questions**

1. What is the difference between theoretical and percent yield?
2. How many grams of copper can be produced from 8.0g CuSO4? Use the equation above.

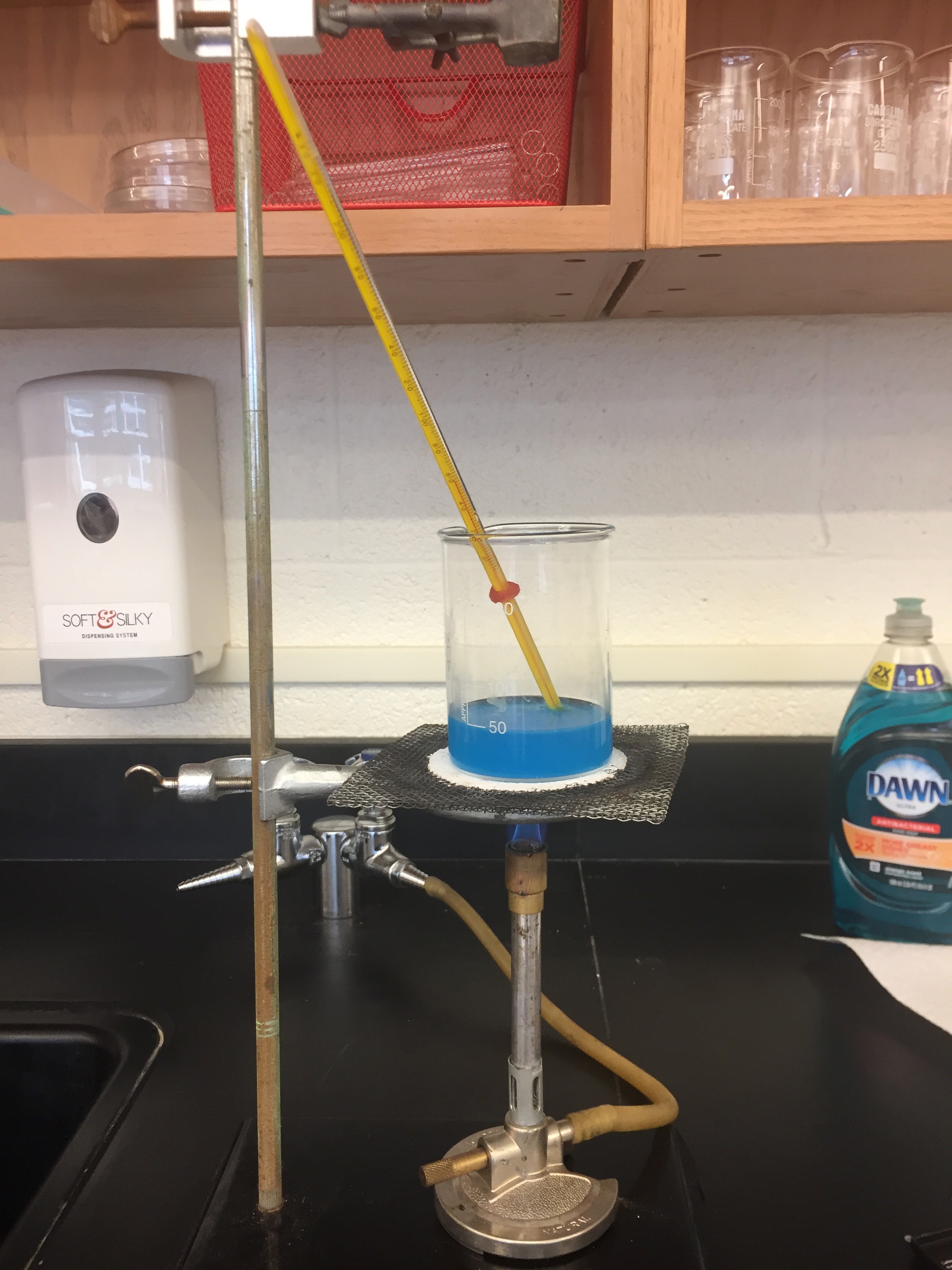
|  |  |  |  |
| --- | --- | --- | --- |
| 8g CuSO4 | 1 mol CuSO4 | mol Cu | g Cu (molar mass) |
|  | g CuSO4 (molar mass) | mol CuSO4 | 1 mol Cu |

1. How many grams of copper can be produced from 1.5g Fe? Use the equation above.

|  |  |  |  |
| --- | --- | --- | --- |
| 1.5 g Fe |  |  |  |
|  |  |  |  |

1. In the lab, the reaction from #3 (above) produced 5 grams of copper (Cu). What is your percent yield?

**Procedure**

1. Measure about 8.0 grams of copper sulfate powder and place them in the 250-mL beaker. Record the actual mass of the powder.
2. Obtain 1.2 to 1.5 grams of iron filings. Record the mass.
3. Measure 50.0 mL of distilled water in a graduated cylinder and add it to the CuSO4 powder in the beaker.
4. ****Set up the ring stand with the ring and wire mesh.
5. Heat the mixture in the beaker to just below boiling (~95 degrees Celsius). Stir continuously with the thermometer. DO NOT ALLOW THE LIQUID TO BOIL.
6. Within one minute of removing the beaker from heat, add the iron filings, in small amounts at a time, to the hot copper sulfate solution. Stir continuously. After all the iron has been added and the mixture stirred, allow the beaker to sit for 10 minutes while the reaction proceeds. Record your observations. You do not need to stir the whole time.
7. Record the mass of a piece of filter paper with you initials written on it.
8. Set up a filtration apparatus by placing your piece of filter paper into a funnel and placing the funnel on top of an Erlenmeyer flask.
9. Decant the liquid into the filter paper slowly. Try not to allow any solid to get on the filter paper.
10. With distilled water, rinse your solid in the beaker. Let the solid settle and decant the liquid. Repeat the washing twice more. The last time, guide all the solid into the filter paper. You can use your scoopula to get as much of it out of the beaker as possible.
11. Place the filter paper in the 100-mL beaker. Place it on the windowsill to dry.
12. The next day, record the final mass of your filter paper + solid copper.

**Data Table**

|  |  |
| --- | --- |
| DAY 1 | |
| Mass of copper sulfate powder |  |
| Mass of iron filings |  |
| Mass of filter paper |  |
| DAY 2 | |
| Mass of filter paper + copper |  |
| Mass of just copper (minus filter paper) |  |

**Observations**

|  |
| --- |
|  |

**Post-Lab Questions**

1. Determine your theoretical yield of copper produced from your original mass of iron filings.
2. Calculate your percent yield.
3. What are some factors that could have contributed to your percent yield? Explain in at least 3 complete sentences.